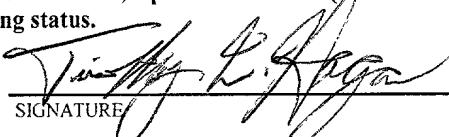


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|---|--|---|--|---|
| FORM PTO-1390 (REV. 11-2000) | | U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE | | ATTORNEY'S DOCKET NUMBER |
| TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371 | | | | WEB 0044 PA |
| INTERNATIONAL APPLICATION NO. PCT/EP00/00031 | | INTERNATIONAL FILING DATE 05 January 2000 | | U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/914005 |
| TITLE OF INVENTION MEMBRANE AND USE THEREOF | | | | PRIORITY DATE CLAIMED 24 February 1999 |
| APPLICANT(S) FOR DO/EO/US Krause et al | | | | |
| Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information: | | | | |
| <p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</p> <p>4. <input type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p>a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</p> <p>b. <input checked="" type="checkbox"/> has been communicated by the International Bureau.</p> <p>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</p> <p>6. <input checked="" type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <p>a. <input checked="" type="checkbox"/> is attached hereto.</p> <p>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p>a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</p> <p>b. <input type="checkbox"/> have been communicated by the International Bureau.</p> <p>c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p>d. <input checked="" type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> | | | | |
| <p>Items 11 to 20 below concern document(s) or information included:</p> <p>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</p> <p>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</p> <p>20. <input checked="" type="checkbox"/> Other items or information: Certificate of Express Mail filing Credit card payment form</p> | | | | |

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|--|--|---|------------|--------|
| 09/914005 U.S. APPLICATION NO. (if known, see 37 CFR 1.49) | INTERNATIONAL APPLICATION NO PCT/EP00/00031 | ATTORNEY'S DOCKET NUMBER WEB 0044 PA | | |
| 21. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1000.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$860.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$710.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$690.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00 | | CALCULATIONS PTO USE ONLY | | |
| ENTER APPROPRIATE BASIC FEE AMOUNT = | | \$ 860.00 | | |
| Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)). | | \$ -0- | | |
| CLAIMS | NUMBER FILED | NUMBER EXTRA | RATE | \$ |
| Total claims | 19 - 20 = | 0 | x \$18.00 | \$ -0- |
| Independent claims | 2 - 3 = | 0 | x \$80.00 | \$ -0- |
| MULTIPLE DEPENDENT CLAIM(S) (if applicable) | | 0 | + \$270.00 | \$ -0- |
| TOTAL OF ABOVE CALCULATIONS = | | \$ 860.00 | | |
| <input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. | | + \$ 430.00 | | |
| SUBTOTAL = | | \$ 430.00 | | |
| Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)). | | \$ -0- | | |
| TOTAL NATIONAL FEE = | | \$ 430.00 | | |
| Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property | | + \$ 40.00 | | |
| TOTAL FEES ENCLOSED = | | \$ 470.00 | | |
| | | Amount to be refunded: | \$ | |
| | | charged: | \$ | |
| a. <input type="checkbox"/> A check in the amount of \$ _____ to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. _____. A duplicate copy of this sheet is enclosed. d. <input checked="" type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038. | | | | |
| NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status. | | | | |
| SEND ALL CORRESPONDENCE TO Timothy W. Hagan, Esq. Killworth Gottman Hagan & Schaeff, LLP One Dayton Centre, Suite 500 One South Main Street Dayton, Ohio 45402-2023 | | | | |
|  SIGNATURE Timothy W. Hagan NAME 29,001 REGISTRATION NUMBER | | | | |

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of

Applicants : Bernd Krause, Matthias Wessling and Heiner Strathmann
Title : MEMBRANE AND USE THEREOF
Docket No. : WEB 0044 PA

Commissioner For Patents
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

Prior to examination of the above-identified patent application, please amend the application as follows.

IN THE CLAIMS

Please cancel claims 1-15.

Please add the following new claims 16-34:

16. A method of making a polymeric membrane comprising:
providing a polymer or mix of polymers and forming said polymer or mix of polymers into a predetermined shape, said polymer or mix of polymers containing from about 0.05 to about 4.5% by weight of a fluid that dissolves or swells the polymer or mix of polymers;

charging said polymer or mix of polymers with a gas;

foaming said polymer or mix of polymers at a temperature above the glass transition temperature of the polymer/gas mixture; and

stabilizing the resulting foam structure by cooling.

17. A method as claimed in claim 16 in which said fluid is infiltrated into said polymer or polymer mix.

18. A method as claimed in claim 16 in which said fluid is added to said polymer or polymer mix during manufacture.

19. A method as claimed in claim 16 in which said fluid comprises a gas or liquid.
20. A method as claimed in claim 19 in which said fluid comprises an organic liquid.
21. A method as claimed in claim 16 wherein after shaping, said polymer or polymer mix is charged with gas at a temperature below the glass transition temperature of the polymer/gas mixture, and is foamed by increasing the temperature to above the glass transition temperature of the polymer/gas mixture.
22. A method as claimed in claim 16 wherein after shaping, said polymer or polymer mix is charged with gas at a temperature above the glass transition temperature of the polymer/gas mixture, and is foamed by reducing pressure.
23. A method as claimed in claim 16 wherein said polymer or polymer mix is heated to a temperature above the glass transition temperature of said polymer or polymer mix, gas is charged into said polymer or polymer mix in an extruder, and upon extrusion said polymer or polymer mix is foamed due to the resulting drop in pressure.
24. A method as claimed in claim 16 wherein the charging gas is selected from the group consisting of air, noble gases, nitrogen, tetrafluoroethylene, fluoroform, hexafluoroethane, carbon dioxide, and mixtures thereof.
25. A method as claimed in claim 16 wherein the charging gas comprises carbon dioxide.
26. A method as claimed in claim 16 in which said polymer or polymer mix is saturated with the charging gas.
27. A method as claimed in claim 16 wherein the polymer or polymer mix is foamed at a temperature of between about 100° to about 200°C.

28. A method as claimed in claim 16 in which said fluid is selected from the group consisting of tetrahydrofuran, 1,2-dichloroethane, 1-methyl-2-pyrrolidone, and mixtures thereof.
29. A method as claimed in claim 16 in which said polymer is selected from the group consisting of polysulfone, polyethersulfone, polycarbonate, cellulose, a cellulose derivative, and mixtures thereof.
30. An open-pore, surface fiber membrane produced by the process of claim 16.
31. An open-pore, hollow fiber membrane produced by the method of claim 16.
32. A membrane as claimed in claim 30 in which said membrane is asymmetrical.
33. A membrane as claimed in claim 31 in which said membrane is asymmetrical.
34. The use of a membrane made by the process of claim 16 for gas separation, hemodialysis, blood filtration, hemodiafiltration, plasmaphoresis, immunotherapy, microfiltration, or ultrafiltration.

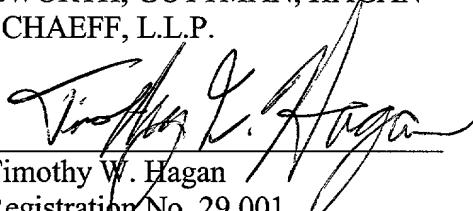
Docket No. WEB 0044 PA

REMARKS

This amendment is being made to place the claims in better form for examination and to eliminate multiple claim dependency.

Respectfully submitted,
KILLWORTH, GOTTMAN, HAGAN
& SCHAEFF, L.L.P.

By


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TWH/amm

09/914005
JC03 Rec'd PCT/PTO 21 AUG 2001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

VERIFICATION OF TRANSLATION

I, LESLEY MARY HARRIS, Master of Arts, Diploma in Translation, of Ridgeback House, Curdrige Lane, Curdrige, Hampshire SO32 2BJ, England, do hereby declare that I am conversant with the English and German languages and that I am a competent translator thereof; I verify that the attached English translation is a true and correct translation made by me of the attached documents in the German language;

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment or both under section 1001 of Title 18 of the United States code and that such wilful false statements may jeopardise the validity of the application or any patent issued thereon.

Date: July 18th, 2001



L M Harris

Membrane and use thereof

The invention relates to membranes, in particular open pore membranes that can be used for gas separation, ultra filtration or in particular for medical purposes such as for 5 haemodialysis, blood filtration, haemodiafiltration, plasma phoresis or immunotherapy.

A method for manufacturing polymer hollow fibre membranes is known from DE-A-19 520 188 in which a molten polymer for forming the hollow fibre membranes is lead 10 through an extrusion apparatus, wherein the polymer, under pressure before entry into an extrusion tool that shapes the molten mass, belonging to the extrusion apparatus, is charged with gas, and wherein as a result of the drop in pressure occurring to a pre-determined extent when the polymer exits the extrusion apparatus and the consequently occurring expansion of the gas in the polymer, a porous hollow fibre 15 membrane forms. The open porosity and pore size obtained using this method do not produce satisfactory separation results as the open porosity percentage is too low and the pores are too large. The pore size determines the separating action and the degree of open porosity the efficiency of the membrane.

20 WO 91/08 243 describes a method for manufacturing open cell polyurethane foam by mixing a di-isocyanate, a hydrogen donor, at least one surface active material, at least one catalyst and a blowing agent, which is advantageously carbon dioxide, pressurising the mixture in the mixing area in order to keep the blowing agent in a liquid state at ambient temperature, ejection of the mixture into an environment at atmospheric 25 pressure with momentary vaporisation of the blowing agent and curing of the resulting foam at ambient temperature. This method has the same disadvantages as that described hereinabove.

The object of the invention is thus to provide open pore membranes, in particular surface fibre membranes or hollow fibre membranes, that have as high a degree of open porosity as possible as well as open pores that are as small and regular in size as possible.

5

According to the invention, this object is solved with a membrane that can be manufactured in that a polymer or polymer mix is shaped as desired, the polymer or polymer mix is charged with a gas at above atmospheric pressure before or after shaping, and then the gas-charged polymer is foamed at a temperature above the glass transition temperature of the polymer/gas mixture, and lastly the foam structure is stabilised by cooling. According to the invention, this method is characterised in that the gas-charged polymer is foamed using an amount of 0.05 to 4.0% by weight of a fluid that dissolves or swells the polymer. This is a liquid or a gas, preferably an organic liquid. Liquids that dissolve the polymer are preferred.

10
15

Until now it was usual to process foams with the type of method described, using solvent-free polymer. It was unexpected that in the presence of a small amount of a fluid that dissolves or swells the polymer, which will hereinafter also be referred to as a solvent, the pore structure is improved in terms of the object of the invention, that is to say a high degree of open porosity and uniformly small pore size is obtained.

Evaluation of the open porosity can be carried out in the following ways:

- a) With the aid of scanning electron microscope pictures;

With this the sample is broken in liquid nitrogen, and the cleavages analysed. If the scanning electron microscope pictures show apertures or fractures in the cell walls, this indicates open porosity.

b) With the aid of flow measurements:

With this, a sample is fixed into an appropriate measuring apparatus, wherein the ends of the membrane are respectively broken in liquid nitrogen. The sample is embedded in a resin so that the top surfaces and lateral surfaces are completely covered over. A gas or a liquid, which can be pressurised, is applied to an open end. By measuring the flow volume of gas or liquid, the open porosity can be characterised. The open porosity is indicated by a significantly higher flow compared to closed pore samples.

10 c) By measuring the capillary elevation:

With this, a sample is fixed into an appropriate measuring installation, wherein the ends of the polymer sample are respectively broken in liquid nitrogen. The end of the fixed sample is immersed approximately 2 to 3 mm in a liquid. After an appropriate time the elevation of the liquid level in the membrane is measured. Using changes in weight as well as elevation, the open porosity can be characterised. Closed pore samples absorb no liquid, and the elevation cannot be measured.

For manufacturing the open pore membranes according to the invention, there are three types of method to be considered that are known per se. The first type of method 20 is the so-called pressurised cell method, in which the polymer or the polymer mix is firstly shaped as required and then, at atmospheric pressure and at a temperature below the glass transition temperature of the polymer/gas mixture, is charged with a gas. The temperature is then raised above the glass transition temperature of the polymer/gas mixture such as by immersion into a hot bath, and the gas is then driven out of the 25 blank, whereby the desired open porosity is produced.

The second type of method is the so-called autoclave method, in which the charging of

the polymer or of the polymer mix with the gas takes place at a temperature above the glass transition temperature of the polymer/gas mixture, and foaming is initiated by a spontaneous increase in pressure. In contrast to the pressurised cell method, in which the gas-charged polymer is normally put into a hot bath in order to obtain the 5 temperature above the glass transition temperature, with the autoclave method, such heating is unnecessary, as the polymer is already at the necessary temperature above the glass transition temperature when charged with the gas.

10 The third type of method is the so-called extrusion method, in which a molten mass of polymer or polymer mix is charged with the gas in a shaping extrusion tool. On leaving the extrusion tool, and the drop in pressure caused by this, foaming occurs.

The pressurised cell method is currently preferred.

15 The liquid dissolving or swelling the polymer can be introduced into the solvent-free polymer or polymer mix by infiltration. Infiltration can take place as follows. The solvent-free polymer (total residue <0.01%) is treated in a flow reactor with a stream of gas enriched with solvent. With this, the solvent concentration in the polymer is increased. With the aid of temperature, gas stream, dwell time, and solvent 20 concentration in the gas stream, different solvent concentrations can be put into the polymer. Treatment is also conceivable in which the polymer is situated in a vapour chamber saturated with solvent. It is preferable, however, as it is technically more simple, to leave the dissolving or swelling liquid as a residue in the polymer during manufacture of the polymer or polymer mix. Optionally, both kinds of method can be 25 employed together, for example, when during the manufacture of the polymer too little residue remains in the polymer or polymer mix, so supplementing by infiltration has to take place.

The content of liquid that dissolves or swells the polymer necessary for the result desired depends on the respective polymers and solvents used. Because of the objects described hereinabove, however, it is a simple matter for the skilled person to determine, using a few routine experiments, what solvent content is optimum for a certain polymer and a certain solvent, and with established parameters such as gassing pressure when charging the polymer with the gas, and foaming temperature.

10 Regardless of the type of method, different charging gases such as air, noble gases, nitrogen, tetrafluoroethylene, fluoroform, hexafluoroethane or mixtures of these can be used, as is known from the prior art. Carbon dioxide is, however, preferably used as the charging gas. Advantageously, the polymer or the polymer mix is saturated under pressure with the charging gas.

15 The pore structure obtained by foaming must be stabilised by cooling the polymer blank. In order to prevent later changes in the pore structure during cooling, it is advantageous to stabilise the polymer blank after foaming by chilling, preferably to a temperature below the glass transition temperature of the polymer.

20 The foaming temperature depends on the specifically used polymer. Normally, the foaming temperature is in the range of 100 to 200°C, but the subject-matter of the invention is not limited to this temperature range. The liquids, preferably organic, that dissolve or swell the polymer, that were used in the previous method, also depend on the polymers used and their solubility. Advantageous examples of these organic liquids are tetrahydrofuran, 1,2-dichloroethane and 1-methyl-2-pyrrolidone

25 Amorphous plastics, partly crystalline plastics, liquid crystal plastics, duroplastics,

elastic rubber plastics or mixtures of these can be considered as polymers in the method described above. Advantageous examples of polymers are polysulfone, polyethersulfone, polyetherketone, polyaramide, polycarbonate, cellulose and cellulose derivatives such as cellulose ester or cellulose ether.

5

As described hereinabove, it is particularly advantageous to manufacture the membranes according to the invention in the form of a surface or hollow fibre membrane. Such membranes can be used for gas separation, preferably also for medicinal purposes such as haemodialysis, blood filtration, haemodiafiltration, plasma 10 phoresis or immunotherapy, or also for non-medical purposes such as for micro or ultrafiltration. According to the purpose for which they are used, the membranes can be symmetrical or asymmetrical, wherein asymmetrical means there is a larger pore size with respect to one of the two surfaces than with respect to the other surface, or even having closed pores or a closed skin on one surface.

15

The following examples serve to explain the invention in more detail.

Examples

20 The following examples are implemented in every respect in the manner described hereinafter, wherein only the polymers, solvents and foaming temperatures have been changed.

25 The given polymer was dissolved in a quantity of 20% by weight in the solvent described hereinafter. This solution was spread with a spreading blade to a thickness of 0.50 mm onto a glass plate. The polymer film was dried in a nitrogen gas stream.

In order to adjust the solvent residue concentration additional drying took place in a vacuum drying chamber. The solvent residue concentration was varied.

The solvent residue-containing polymer film thus obtained was saturated with carbon dioxide at 50 bar and at approximately 20 to 25° for 2 hours in a pressurised cell. After releasing the pressure and opening the pressurised cell, the polymer film was immersed for 10 to 60 seconds in a hot bath at the foaming temperature described hereinafter. After foaming, the polymer film was chilled to approximately 20° in a mixture of ethanol and water.

10

Example 1

In this example, a polysulfone (Udel P-3500, Amoko) was used as the polymer with solvent residue concentrations of tetrahydrofuran. A foaming temperature of 165°C was used. Open cell membranes were respectively obtained with a solvent residue content (tetrahydrofuran) of 1.23% by weight, 0.94% by weight, 0.68% by weight 0.38% by weight, 0.33% by weight, 0.24% by weight, 0.10% by weight and 0.07% by weight. When the solvent residue content was reduced to 0.01%, closed cell membranes were obtained instead.

20

Example 2

Example 1 was repeated using 1,2 dichloroethane. With a solvent residue content of 3.4% by weight and a foaming temperature of 165°C, an open cell membrane was obtained. With 8.0% by weight solvent residue content, however, only closed cell membranes were obtained.

25

Example 3

In this example, instead of polysulfone, a polyethersulfone (5200-P, ICI) was used as the polymer. As the organic liquid or solvent, 1-methyl-2-pyrrolidone was used. The foaming temperature was approximately 185°C. Open cell membranes were obtained with a solvent residue content of 4.39% by weight, 4.3% by weight, 3.54% by weight, 5 3.47% by weight and 2.48% by weight. With a solvent residue content of 5.66% by weight, however, the membranes were closed-celled.

Example 4

In this example, a polycarbonate (BPZ-PC S 24/4, Bayer) was used as the polymer in 10 combination with tetrahydrofuran as the solvent and a foaming temperature of 140°C. With solvent residue contents of 0.50% by weight, 0.36% by weight and 0.31% by weight, open cell membranes were produced.

Claims

1. Membrane, that can be manufactured in that a polymer or polymer mix is shaped as required, is charged with a gas at above atmospheric pressure before or after shaping, then the gas-charged polymer is foamed at a temperature above the glass transition temperature of the polymer/gas mixture, and lastly, the foam structure is stabilised by cooling, characterised in that the gas charged polymer is foamed using an amount of 0.05% to 4.5% by weight of a fluid that dissolves or swells the polymer.

10

2. Membrane according to claim 1, characterised in that after shaping, the polymer or polymer mix is charged with the gas at a temperature below the glass transition temperature of the polymer/gas mixture, and then is foamed by increasing the temperature to above the glass transition temperature of the polymer/gas mixture.

15

3. Membrane according to claim 1, characterised in that gas-charging is done after shaping at a temperature above the glass transition temperature of the polymer/gas mixture, and then foaming by reduction of pressure.

20

4. Membrane according to claim 1, characterised in that before shaping, the molten mass of polymer or polymer mix is charged with the gas in an extrusion tool, and upon extrusion is foamed due to the resultant drop in pressure that occurs.

25

5. Membrane according to one of claims 1 to 4, characterised in that the fluid that

dissolves or swells the polymer is an organic liquid, preferably one that dissolves the polymer.

5

6. Membrane according to one of claims 1 to 5, characterised in that when foaming takes place, the polymer contains the fluid that dissolves or swells the polymer in the form of solvent residue or in the form of infiltrated solvent.

10

7. Membrane according to one of claims 1 to 6, characterised in that the amount of the fluid that dissolves or swells the polymer is optimised depending on the polymer used, the solvent used, the gas-charging pressure when the polymer is charged with the gas, and the foaming temperature.

15

8. Membrane according to one of claims 1 to 7, characterised in that carbon dioxide is used as the charging gas.

19

9. Membrane according to one of claims 1 to 8, characterised in that the polymer is saturated under pressure with the charging gas.

20

10. Membrane according to one of claims 1 to 9, characterised in that the foam structure is stabilised by chilling after foaming.

25

11. Membrane according to one of claims 1 to 10, characterised in that a foaming temperature of 100 to 200°C is employed.

12. Membrane according to one of claims 5 to 11, characterised in that tetrahydrofuran, 1,2-dichloroethane or 1-methyl-2-pyrrolidone is used as the organic liquid that dissolves or swells the polymer.

5 13. Membrane according to one of claims 1 to 12, characterised in that a polysulfone, polyethersulfone, polycarbonate, cellulose or a cellulose derivative is used as the polymer.

10 14. Membrane according to one of claims 1 to 13, characterised in that it is in the form of a surface fibre or hollow fibre membrane.

15 15. Use of a surface or hollow fibre membrane manufactured according to claim 14 for medical purposes, in particular for haemodialysis, blood filtration, haemodiafiltration, plasma phoresis or immunotherapy, or for micro or ultrafiltration.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

**DECLARATION FOR UTILITY OR
DESIGN
PATENT APPLICATION**
(37 CFR 1.63)

Declaration Submitted with Initial Filing

OR

Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

| | |
|--------------------------|-----------------|
| Attorney Docket Number | WEB 0044 PA |
| First Named Inventor | KRAUSE, Bernd |
| COMPLETE IF KNOWN | |
| Application Number | 09 / 914,005 |
| Filing Date | August 21, 2001 |
| Group Art Unit | |
| Examiner Name | |

As a below named inventor, I hereby declare that:

My residence, mailing address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MEMBRANE AND USE THEREOF

(Title of the Invention)

the specification of which

is attached hereto

OR

was filed on (MM/DD/YYYY) 01/05/2000 X as United States Application Number or PCT International

Application Number PCT/EP00/00031 and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed.

| Prior Foreign Application Number(s) | Country | Foreign Filing Date (MM/DD/YYYY) | Priority Not Claimed | Certified Copy Attached? | |
|-------------------------------------|---------|----------------------------------|--|--|---|
| | | | | YES | NO |
| 199 07 824.6 | Germany | 02/24/1999 | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> |

Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

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DECLARATION — Utility or Design Patent Application

Direct all correspondence to: Customer Number or Bar Code Label  OR Correspondence address below

23368

PATENT TRADEMARK OFFICE

Name

BERND KRAUSE

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DECLARATION

ADDITIONAL INVENTOR(S) Supplemental Sheet Page 3 of 3

| | | | |
|---|--------------------------|---|------------------------------|
| Name of Additional Joint Inventor, if any: | | <input type="checkbox"/> A petition has been filed for this unsigned inventor | |
| Given Name (first and middle [if any]) <i>Heiner</i> | | Family Name or Surname <i>Strathmann</i> | |
| Inventor's Signature | <i>Heiner Strathmann</i> | | Date <i>September 6, 01.</i> |
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| Name of Additional Joint Inventor, if any: | | <input type="checkbox"/> A petition has been filed for this unsigned inventor | |
| Given Name (first and middle [if any]) | | Family Name or Surname | |
| Inventor's Signature | | | Date |
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| Name of Additional Joint Inventor, if any: | | <input type="checkbox"/> A petition has been filed for this unsigned inventor | |
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